BIONOMIC NOTES ON EXARTEMA FERRIFERANUM WALK. (LEPID., OLETHREUTIDÆ) AND ITS PARASITES (HYM: BRAC., CHALC.)*

By W. V. Balduf
University of Illinois

The genus *Exartema* is a group of Tortricoid moths which has interfered but little with the cultivation of economic plants in North America. Slingerland and Crosby (14) gave brief accounts of *E. malanum* Fernald, the apple budworm, and *E. permundanum* Clem., the raspberry leaf-roller. The food plants of several other members of the genus are cited by Kearfott (07) and Heinrich (23). *E. ferriferanum* Walker was described in 1863 from Virginia and subsequently renamed by Clemens and Zeller (Dyar, 02), but nothing seems to have been recorded concerning its bionomics. The writer submits observations on approximately twenty individuals of *ferriferanum* found on *Hydrangea* in and near Urbana, Illinois, in May and June of 1936.

Attention was attracted to it by the conspicuous cases formed by the larva from the succulent and still immature terminal leaves. The majority of these leaf-cases occurred on the cultivated species, *Hydrangea arborescens grandiflora*, a few on the wild form, *H. arborescens* growing in the writer's garden, and one dried case was taken on a wild plant in nature early in September. In most instances the cases were composed of a pair of opposite leaves whose upper surfaces were brought face to face, but united by larval silk only along the margins which were precisely coextensive, while the discal areas of the two blades bulged out roundly. In several instances the case consisted of but a single leaf, the leaf blade then being doubled symmetrically upon itself along the mid-

* Contribution Number 185 from the entomological laboratories of the University of Illinois.

The writer gratefully acknowledges the services of Messrs. A. B. Gahan, Carl Heinrich and C. F. W. Muesebeck, all of the U. S. National Museum, in determining the insects, and of Mr. James Hutchinson, University of Illinois, who identified the plants, concerned in this paper.

rib, and the margins of the leaf held together neatly with silk. The leaf-cases of *E. ferriferanum* therefore assume two distinct shapes, but are alike in possessing an inflated appearance. Only a relatively small part of the lumen of the case is utilized by the inhabiting insect. In the center of the interior, the larva constructs a rather light cocoon which appears to consist of bits of excreta or vegetable substance united and lined inside with silk. In this cocoon within the leaf-case the larva transforms to the adult state.

When discovered on May 31, this insect had largely completed its larval life. One larva had begun to shorten and thicken in preparation for pupation, and all others had already become chrysalises or ceased development owing to parasitism. During the period of June 2 to 10, ten moths issued from their leaf-cases, invariably leaving the empty chrysalises sticking cephalic end outward through a circular hole in the leaf. The hole was, in all probability, cut by the mature larva and always occurred at a point near the head end of the cocoon with which the aperture seemed to be joined by a short silken runway. Since the leaves involved in the construction of the leaf cases bore no noticeable evidence of larval feeding, it is possible that the cases are built exclusively to shelter the insect during its pupal period. Failure to find such leaf-cases again during July, August and September suggests that *E. ferriferanum* undergoes only one generation per year in central Illinois and may spend most of the summer as well as the winter in the adult or egg stage, if, indeed, it has no alternate food plants.

The following brief descriptions of the three stages observed may serve to distinguish this species from similar species that may frequent *Hydrangea.*

Adult.—Very similar to the codling moth in size and shape of the wings; hind pair plain, moderately smoky above, dull silvery below; front pair largely smoky black beneath, the upper surface with a basal rusty brown patch and another of the same color but roughly spindle-shaped extending obliquely across the outer-anterior quarter, rest of surface whitish-yellow and irregularly speckled rusty brown.

Mature larva.—Length 15 mm., body medium green with head

and pronotal shield dark brown, thoracic legs and mouth parts more or less chitin-brown; surface microscopically and densely setose, and very sparsely hairy; crochets of first four pairs of prolegs forming a complete circlet, those of anal pair horse-shoe like in pattern, open behind.

Chrysalis.—Length 9–11 mm. (2 specimens); pale to deep brown, shiny; surface densely and microscopically setose; cremaster of eight feebly curved hooks; subapical longitudinal slit on venter of last abdominal segment; seven pairs of abdominal spiracles, pairs 3 to 7 situated beyond tips of wing cases; each spiracle-bearing segment provided dorsally with two transverse rows of short pointed stout creeping spurs none of which extend beyond spiracles laterally; the number of spurs per row per segment is given in the accompanying table, the numbers in the squares referring to the first and the second specimens, respectively:

Segment Number	1	2	3	4	5	6	7
First Row	7,8	13,12	18,17	15,17	16,18	14,15	13,9
Second Row	21,23	28,30	21,33	23,31	21,28	10,13	11,7

Two species of Hymenoptera were reared from the material of *Exartema* described above. One male of the Braconid, *Microgaster epagoges* Gahan issued on June 6, 1936, from a plain white elongate-oval cocoon measuring 5.5 mm. long and found within the rather flimsy cocoon of *E. ferriferanum* in the usual leaf-case. No trace of the host's chrysalis was present. Accordingly, the larva was the host stage parasitized, which, however, succeeded in maturing and constructing its cocoon for pupation but was overcome by the *Microgaster* before changing to the pupal state. Gahan (17) described *M. epagoges* from specimens reared by C. C. Hill from the larvae of the Tortricid, *Epagoge sulfureana* Clem., in Tennessee, and Knull (32) bred it as a parasite of the larvae of *Tortrix argyrospila* Walk.

Three other larvæ of *ferriferanum* were killed by what doubtlessly were *M. epagoges;* the cocoons of each of these caterpillars contained a white cocoon similar in every way to that above from which the male *epagoges* issued. However, these cocoons were in turn parasitized by the Eulophid Chalcid, *Dimmockia pallipes*

(Mues.). Thirty-four *pallipes* came from the three cocoons; dissection of one produced the pupal exuviæ of no less than ten individuals. Muesebeck (27) described *D. pallipes* from specimens hyperparasitic on another Braconid, *Apanteles melanoscelus* (Ratz.), an imported parasite of the gipsy moth. Records available in the Review of Applied Entomology, Ser. A, 1913–1934, show that also other species of *Dimmockia* have been reared as secondary parasites.

REFERENCES CITED

DYAR, H. G. (02), A list of North American Lepidoptera, Bul. 52, U. S. National Museum, 723 pp., 1902.

GAHAN, A. B. (17), Descriptions of some new parasitic Hymenoptera, Proc. U. S. National Museum, 53, 197–198, 1917.

HEINRICH, CARL. (23), New Olethreutidæ from Eastern United States, Proc. Ent. Soc. Wash., 25, 105–122, 1923.

KEARFOTT, W. D. (07), Microlepidoptera from the Black Mountain region of North Carolina, with descriptions of new species, Bul. Amer. Mus. Nat. Hist. N. Y., 23, 156–157, 1907.

KNULL, J. N. (32), Observations on three important forest insects, Jour. Econ. Ent., 25, 1196–1203, 1932.

MUESEBECK, C. F. W. (27), New species of Chalcid flies parasitic on the gipsy-moth parasite, *Apanteles melanoscelus* (Ratz.), Jour. Agr. Res., Bul. 34, 333, 1927.

SLINGERLAND, M. V. AND CROSBY, C. R. (14), Manual of fruit insects, 503 pp., 396 figs., Macmillan Co., 1914.